Space Weather Technical Forecast

Issued on Wednesday, 10 April 2024 at 13:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Increasing chance of Moderate or greater solar activity during the period.

Analysis of Space Weather Activity over past 24 hours.

Solar Activity: Solar activity has remained Low, with a few low-level C-class flares observed during the period by GOES16 and 18. There are four active regions on the Earth facing disc. The largest of these is AR3628 (Cho/Beta) in the northwest disc. It contains a large main spot with continued slight proliferation of minor, mixed polarity spots to the north of the main spot. AR3634 (Bxo/Beta) in the northeast has displayed some growth with minor opposite-polarity spots forming to the rear of the leading spot. AR3629 has now rotated off the visible disc. The remaining regions are relatively simple and inactive.

The current disc is heavily populated by filaments - perhaps rendered more durable by the lack of flares to de-stabilise them. Despite this, no Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: Solar wind parameters, as measured at L1 by DSCOVR are indicative of an ongoing minor coronal hole high-speed stream influence. Solar wind speeds were at slightly elevated levels, generally between 400-450 km/s, with a peak of 486 km/s observed at 09/1919 UTC. The solar wind density was average to below average throughout. Total Interplanetary Magnetic Field (IMF), Bt, was Weak to Moderate, peaking at close to 9nT at 09/1201 UTC. The north-south component, Bz, varied between +7 and -6 nT, with erratic variations between directions. The phi angle was mainly positive (away from the Sun).

Resultant Geomagnetic activity was Quiet to Unsettled.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES18 was at background levels.

High energy electron flux (greater than 2MeV) observed at GOES16 was at background to moderate levels. The associated 24-hour fluence remained well below the Active (1e8 integrated flux) threshold, on an increasing, then steady trend, with a value of 8.3e6 integrated pfu recorded at 10/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low or Very Low activity is expected at first. Activity will potentially increase in the coming days with the return of multiple Ex-sunspot regions over the eastern solar horizon, with a greater chance of Moderate or higher activity.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs feature in the forecast. Minor coronal hole high-speed stream influences are expected through Days 1-3 (10-12 Apr) with speeds persisting at slightly elevated levels at first before easing to normal background. A further enhancement is possible late on Day 4 (13 Apr), but carries low confidence regarding

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timings and geomagnetic effects.

Geomagnetic activity is expected to be Quiet to Unsettled with a chance of isolated Active intervals early on Day 1 (10 Apr). Mainly Quiet activity is then expected through much of, if not the remainder of the period, increasing to become Unsettled to Active should any high-speed stream arrive late on Day 4 (13 Apr).

Energetic Particles / Solar Radiation: High energy proton flux as observed by GOES-18 is expected to persist at background levels. High energy electron flux at GOES16 is expected to continue at background to moderate levels. The associated 24-hour electron fluence is expected to remain well below the Active (1e8 integrated pfu) threshold.

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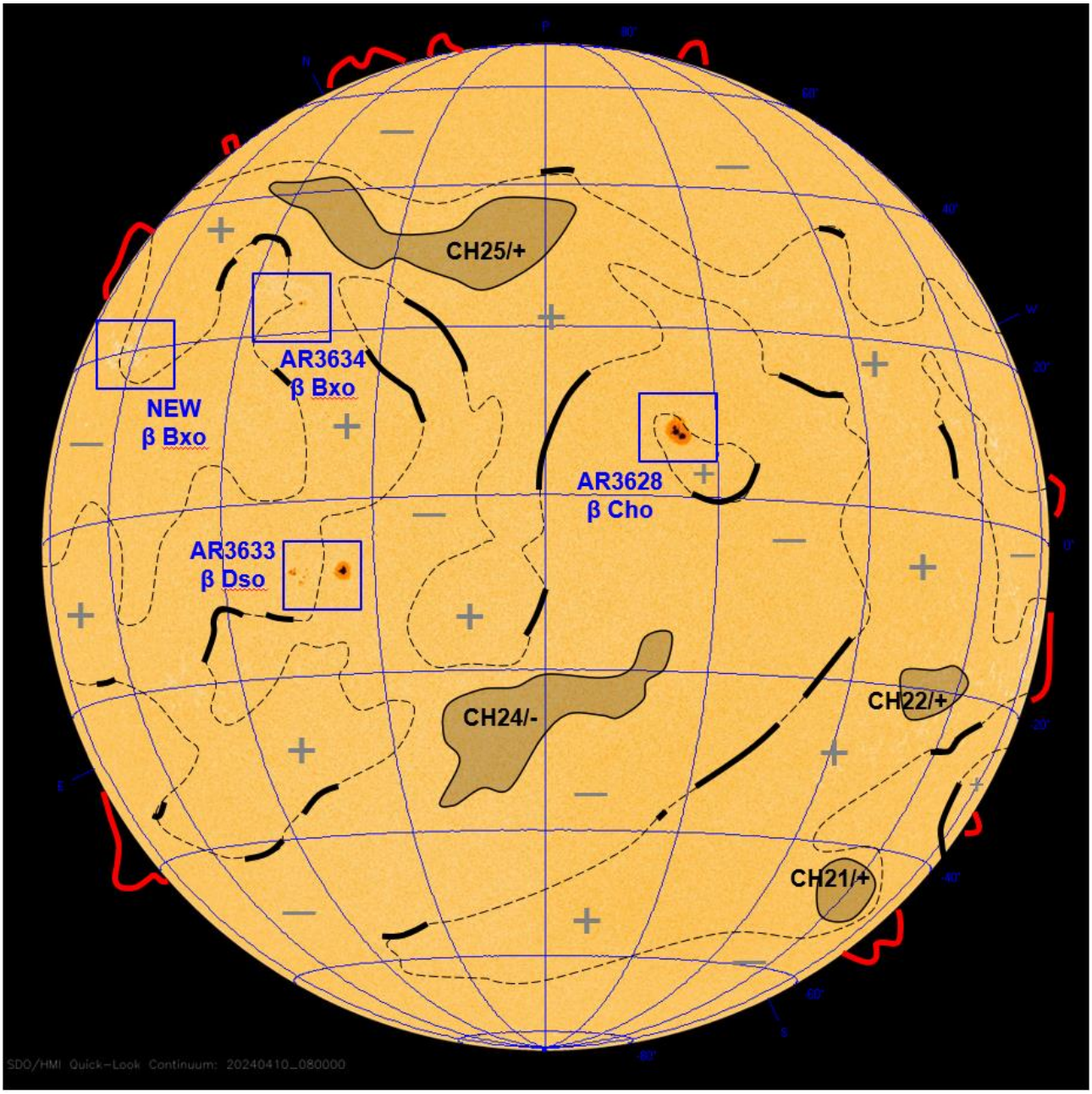
Figure 1. Solar Analysis Valid 10/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:
No CMEs feature in the current forecast, however there are a higher number of 'filaments' than is typical on the Earth-facing side of the Sun – this is likely to seed an increasing risk of geomagnetic activity should any of these erupt in the coming days.

Solar wind speeds are currently slightly elevated due to positive coronal hole high-speed stream influences (mainly coronal hole 22). Speeds should begin to ease from day 2 (11 Apr) onwards, likely returning to background levels. A further enhancement is possible late on day 4 (13 Apr) due to negative polarity coronal hole 24. This is a recurrent feature, but has changed in appearance since the previous rotation from a small, symmetrically shaped coronal hole, to a larger but more elongated feature. Any connection will potentially increase speeds to become slightly elevated or perhaps elevated, though given the irregular, elongated shape of the coronal hole, confidence in the onset of the high-speed stream and subsequent geomagnetic effects is lower than usual.

Another factor in the lower than average confidence in the geomagnetic forecast is MOSWOC Enlil, which is suggesting a notable high speed stream throughout the early period, with winds peaking around 550km/s (elevated) on Day 1 (10 Apr) before declining to slightly elevated by the end of day 4 (13 Apr). Given current conditions in Enlil verifying poorly with actuality, it is considered likely that Enlil is significantly overdone in its forecast. Enlil also appears to have underrepresented coronal hole 24 late in the period, though may improve in subsequent runs.
Geomagnetic activity is expected to be Quiet to Unsettled with a chance of isolated Active intervals early on Day 1 (10 Apr). Mainly Quiet activity is then expected through much of, if not the remainder of the period, increasing to become Unsettled to Active should any high-speed stream arrive late on Day 4 (13 Apr).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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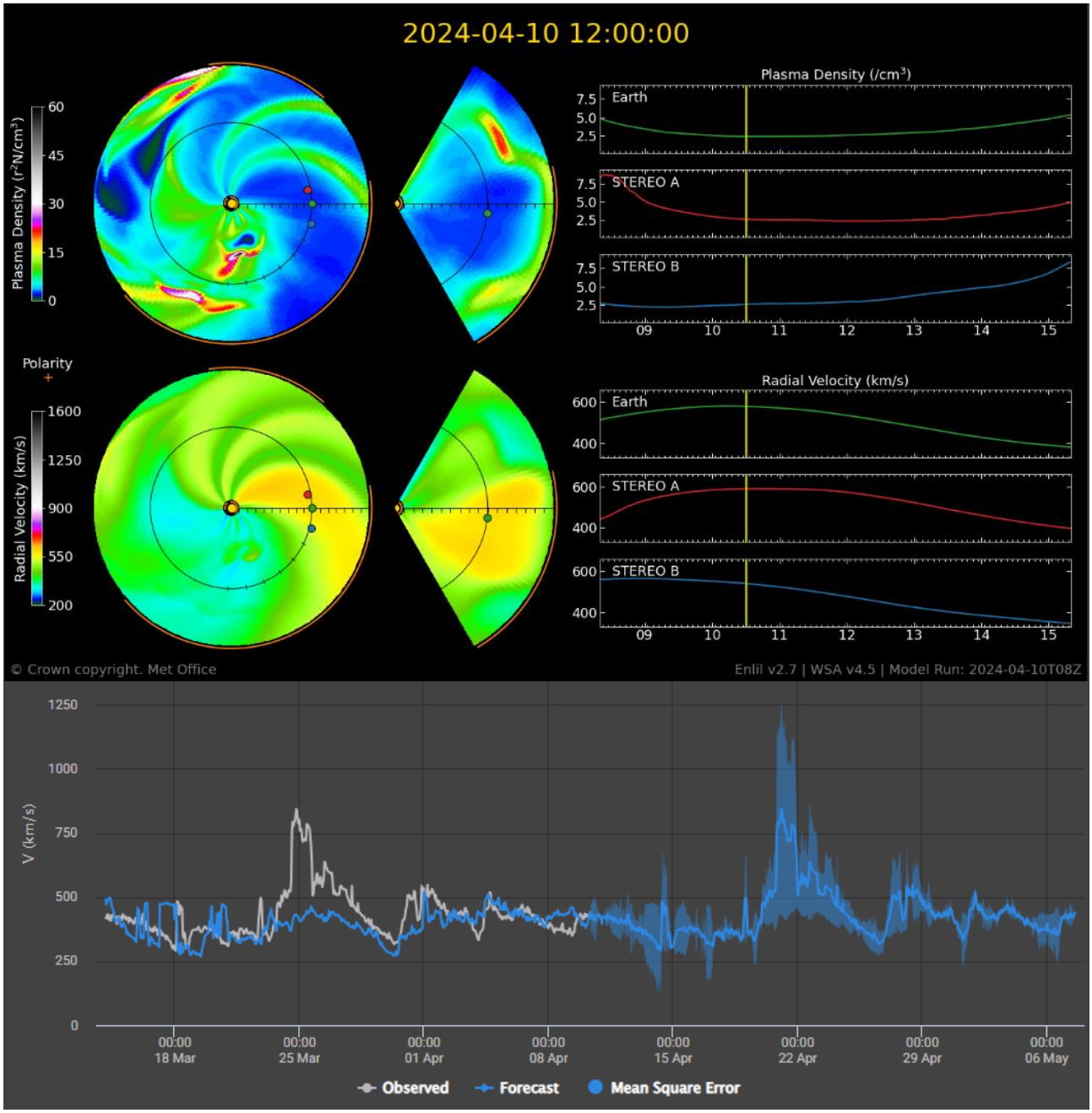
Figure 2: MOSWOC Enlil, currently too high for winds during current coronal hole influences; and MOSWOC SWPM, which is deemed a better guide currently



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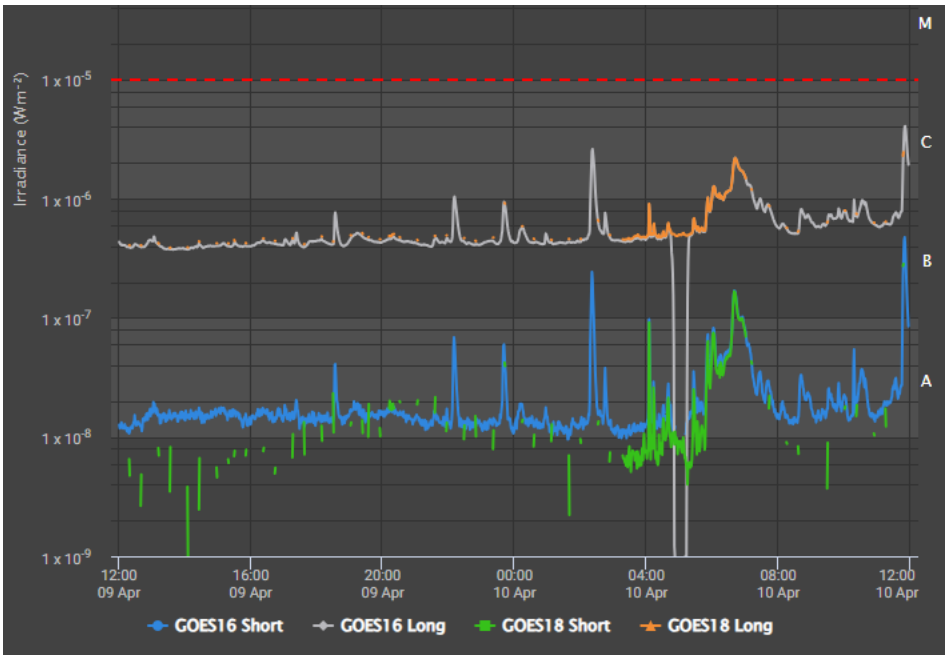
Radio Blackouts - X-Ray Flares:
The facing side of the Sun is currently populated by four, predominantly simple sunspot regions, meaning the risk of significant X-ray flares is lower than it has been for some time – more akin to solar minimum at first. The chances of significant flares should, however, rise significantly in the coming days given the expected arrival of numerous Ex-regions over the eastern solar horizon, including at least one large and complex sunspot group.

SDO/AIA 171 imagery indicates modest magnetic looping at or close to the northeast limb. This is likely Ex-AR3621, which left the disc on 27 Mar as a simple bipolar group. This is due to rotate onto the disc Day 1 (10 Apr). On Day 3 (12 Apr), Ex-regions AR3614, AR3615 and AR3623 are expected to rotate over the eastern solar horizon. Ex-AR3615 was a significant region on the last rotation and is likely to have survived its transit of the far side - supported by imagery from the Mars Perseverance Rover as well as ongoing evidence on far-side seismographs. The chances of significant flares should rise to nearer climatology during the period, with the most notable uptick expected into Day 3 (12 Apr).

Solar activity is expected to remain Low or Very Low, but with a slight chance of Moderate activity, increasing to a chance of Moderate activity from Day 3 (12 Apr) onwards.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	15	40	40
Very Active	R3 to R5 X Class	No	1	1	5	5

Figure 3: GOES 16 & 18 X-ray flux



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Solar Radiation Storms - (High Energy Protons):
High energy proton flux as observed by GOES18 is at background levels. Solar radiation storms are considered a negligible risk during the period given the lack of appropriately-flaring sunspot regions in better-connecting parts of the disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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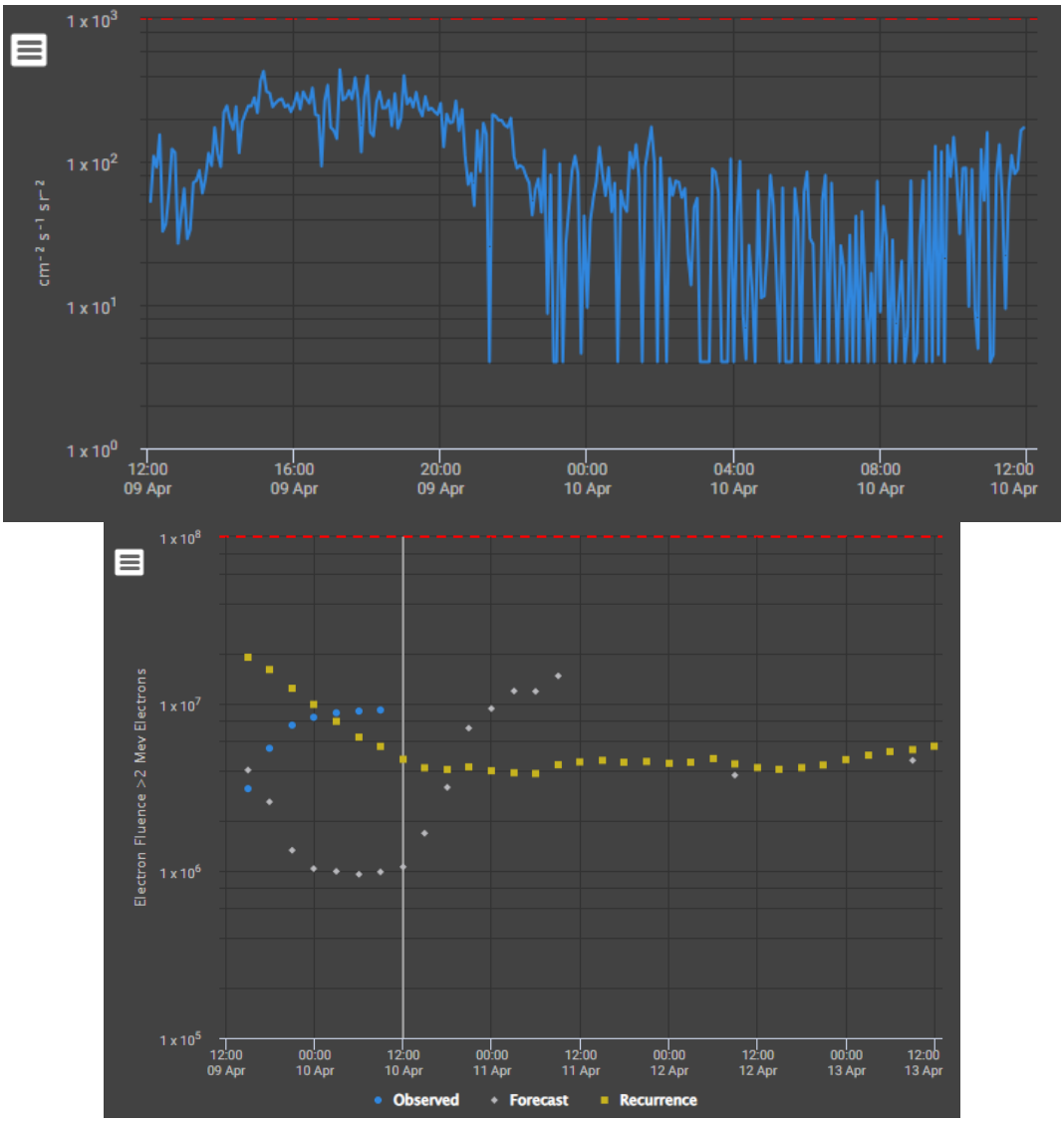
High Energy Electrons Event (≥ 2MeV):
High energy electron flux is currently at normal background to moderate levels. Any high speed streams during the period are expected to be minor, and therefore lacking the impetus necessary to significantly increase electron populations at GEO. Electron fluence is likewise forecast to remain well below the Active (1e8 integrated pfu) threshold throughout the period, with MOSWOC REFM giving reasonable guidance in its largely stable trend.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: GOES 16 Electron flux and MOSWOC REFM



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